PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 17 February 1998 (17.02.98)	
International application No. PCT/SE97/01243	**Applicant's or agent's file reference** AO-11123 DE
International filing date (day/month/year) 08 July 1997 (08.07.97)	**Priority date** (day/month/year) 19 July 1996 (19.07.96)
Applicant WALDENSTRÖM, Mats et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

16 January 1998 (16.01.98)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer M. Fourne-Godbersen
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

ÖSTLUND, Alf
Sandvik AB
Patent Dept.
S-811 81 Sandviken
SUEDE

Date of mailing (day/month/year)
17 February 1998 (17.02.98)

Applicant's or agent's file reference
AO-11123 DE

IMPORTANT NOTIFICATION

International application No.
PCT/SE97/01243

International filing date (day/month/year)
08 July 1997 (08.07.97)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address
WALDENSTRÖM, Mats
Thaliavägen 31
S-161 40 Bromma
Sweden

State of Nationality: SE
State of Residence: SE
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
WALDENSTRÖM, Mats
Thaliavägen 31
S-167 71 Bromma
Sweden

State of Nationality: SE
State of Residence: SE
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
M. Fourne-Godbersen
Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

ÖSTLUND, Alf
Sandvik AB
Patent Dept.
S-811 81 Sandviken
SUEDE

Date of mailing (day/month/year) 17 February 1998 (17.02.98)	
Applicant's or agent's file reference AO-11123 DE	**IMPORTANT NOTIFICATION**
International application No. PCT/SE97/01243	**International filing date** (day/month/year) 08 July 1997 (08.07.97)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
ÖSTLUND, Åke Sedelvägen 12 S-129 32 Hägersten Sweden	SE	SE
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
ÖSTLUND, Åke Sedelvägen 12 S-129 47 Hägersten Sweden	SE	SE
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer M. Fourne-Godbersen
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference AO-11123 DE	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/SE 97/01243	International filing date *(day/month/year)* 8 July 1997	(Earliest) Priority Date *(day/month/year)* 19 July 1996
Applicant Sandvik AB (publ) et al		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] **Certain claims were found unsearchable** (See Box I).

2. [ ] **Unity of invention is lacking** (See Box II).

3. [ ] The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing
   - [ ] filed with the international application.
   - [ ] furnished by the applicant separately from the international application,
     - [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - [ ] transcribed by this Authority.

4. With regard to the title,
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established by this Authority to read as follows:

5. With regard to the abstract,
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:
   Figure No. 1
   - [X] as suggested by the applicant.
   - [ ] because the applicant failed to suggest a figure.
   - [ ] because this figure better characterizes the invention.
   - [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C22C 29/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C22C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4923512 A (ED E. TIMM ET AL), 8 May 1990 (08.05.90), column 3, line 19 - line 40; column 9, line 31 - line 68	1,2,4
A		3,5,6,7-10
	--	
X	US 3660050 A (RALPH K. ILER ET AL), 2 May 1972 (02.05.72), column 1, line 1 - column 3, line 9; column 6, line 11 - line 32; column 9, line 13 - line 55, column 31, line 45 - column 32, line 17	1,3,4
A		2,5-6,7-10
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 1997	12 -11- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Nils Engnell Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0240879 A2 (MITSUBISHI KINZOKU KABUSHIKI KAISHA), 14 October 1987 (14.10.87), column 2, line 1 - line 42	1,2
A		3-6,7-10
	--	
X	Dialog Information Services, File 351,DERWENT WPI, Dialog accession no. 010155859,WPI accession no. 95-057111/199508, (NGK SPARK PLUG CO LTD), "Tungstencarbide-base cemented carbide used for cutting tool - comprises hard phase having specified particle size distribution, and contg tungsten carbide and ferrous metal bonding phase", & JP,A,6335808, 19941206, 199508 B	1,2,3
A		4-6,7-10
	--	
P,X	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 011397725, WPI accession no. 97-375632/199735, (KOBE STEEL LTD), "Hard tough cemented carbide - comprises mainly tungsten carbide, cobalt and nickel", & JP,A,9125185, 19970513, 199735 B	1
A		2-6,7-10
	--	
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 011172064, WPI accession no. 97-149989/199714, (DIJET IND CO LTD), "Sintered hard material for water jet or wire drawing die nozzles - comprises iron, cobalt, and/or nickel, carbide and/or carbonitride of Gp-IVA transition metal, and tungsten carbide", & JP,A,9025535, 19970128, 199714 B	1-6,7,10
	--	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 008723156, WPI accession no. 91-227173/199131, (TOSHIBA TUNGALLOY KK), "Coated sintered hard alloy for intermittent cutting - has single or multilayers of ceramics on matrix of tungsten carbide or gp-IVA, pg-VA or gp-VIA carbide(s) or carbonitride(s)", JP,A, 3146677, 19910621, 199131 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 008551086, WPI accession no. 91-055137/199108, (HITACHI TOOL KK),"Super-hard alloy prodn. - comprises hard phase of titanium-carbide, titanium-nitride and tungsten carbide and binder phase of iron-Gp. metal", JP,A, 3006349, 19910111, 199108 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 004689404, WPI accession no. 86-192746/198630, (HITACHI CHOKO KK), "Ultrafine particles sintered hard alloy - comprises tungsten carbide hard phase bonded with iron and chromium gp elements contg. carbid(s)", JP,A, 61124548, 19860612, 198630 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 004675229, WPI accession no. 86-178571/198628, (HITACHI CHOKO KK et al), "Hard alloy useful for cutting tools etc. comprises hard phase contg. tungsten carbide, and binder metal phase contg. iron-gp. and chromium-gp. elements", JP,A,61110745, 19860529, 198628 B --	1-6,7-10
A	EP 0476632 A2 (KAWASAKI JUKOGYO KABUSHIKI KAISHA), 25 March 1992 (25.03.92), page 4, line 36 - page 5, line 19 -- --------	1-6,7-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/97

International application No.
PCT/SE 97/01243

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4923512 A	08/05/90	NONE	
US 3660050 A	02/05/72	AT 299562 A	15/05/72
		BE 751884 A	14/12/70
		CA 924738 A	17/04/73
		CH 545347 A	31/01/74
		DE 2030666 A	07/01/71
		FR 2047071 A	12/03/71
		GB 1315368 A	02/05/73
		LU 61174 A	24/08/70
		NL 7009125 A	28/12/70
		SE 7411630 A	16/09/74
		SE 7411631 A	16/09/74
		ZA 7004219 A	31/03/71
EP 0240879 A2	14/10/87	SE 0240879 T3	
		DE 3784754 A	22/04/93
		JP 1947234 C	10/07/95
		JP 6076639 B	28/09/94
		JP 62227059 A	06/10/87
		US 5068149 A	26/11/91
		US 5288676 A	22/02/94
		JP 62227060 A	06/10/87
EP 0476632 A2	25/03/92	CA 2051765 A,C	21/03/92
		JP 2599044 B	09/04/97
		JP 4365558 A	17/12/92
		KR 9406286 B	14/07/94
		US 5334561 A	02/08/94
		US 5434112 A	18/07/95
		JP 2540672 B	09/10/96
		JP 4348873 A	03/12/92

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference AO-11123 DE	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/SE97/01243	International filing date *(day/month/year)* 08.07.1997	Priority date *(day/month/year)* 19.07.1996
International Patent Classification (IPC) or national classification and IPC6 C22C 29/08		
Applicant Sandvik AB (publ) et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16.01.1998	02.12.1998
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Nils Engnell Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

CORRECTED

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE97/01243

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages 1-15, as originally filed,
pages _____, filed with the demand,
pages _____, filed with the letter of _____,
pages _____, filed with the letter of _____.

☒ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. 1,2, filed with the letter of 25.08.1998,
Nos. _____, filed with the letter of _____.

☒ the drawings, ~~sheets~~/fig 1-2, as originally filed,
~~sheets~~/fig _____, filed with the demand
~~sheets~~/fig _____, filed with the letter of _____,
~~sheets~~/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE97/01243

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1,2	YES
	Claims		NO
Inventive step (IS)	Claims	1,2	YES
	Claims		NO
Industrial applicability (IA)	Claims	1,2	YES
	Claims		NO

2. Citations and explanations

The originally filed claims are substituted by amended claims 1 and 2 directed to a cemented carbide insert provided with a thin wear resistant coating for machining of steels and stainless steels. According to claim 1, the insert is based on WC, optionally not more than 10 wt-% cubic carbides and 5 - 12.5 wt-% Co. The WC grains have an average grain size in the range 0.2-3.5 µm. The insert is characterised by a WC grain size distribution in the range 0-4.5 µm and by a high content of dissolved W in the cobalt binder phase, which is expressed by a formula. In claim 2 coatings are defined.

Cited document US,A, 3 660 050 relates to a cemented carbide for cutting tools. The material has a very fine structure, *i.e.*, fine WC grains. Preferably WC powder having anisodimensional particles with a thickness of 0.05-1 µm and a length/breadth of 0.2-4 µm is used (col. 4, ll 26-34, col. 6, ll 11-32). In Example 3, a WC powder having grains (particles) in the size range 0.5-2 µm with an average size of - µm is used (col. 28, ll 63-75). There is no indication that the sintered cemented carbides have essentially different grain size characteristics. See also Examples 1, 6 and 10. Therefore, in the cemented carbide according to US, A, 3 660 050 the WC grains have an average grain size in the range 0.2-3.5 µm and a grain size distribution in the range 0-4.5 µm. However, the cemented carbide according to the document has a *heterogenous* binder regarding the W (Tungsten) content in the binder phase, a high content being preferred (col. 4, l 43 - col. 5, l 34). The content of W dissolved in the cobalt binder phase is regulated by the carbon content, *c.f.* the present description p 4, ll 4 - 14.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

Consequently, the invention defined in claim 1 is novel in that a *homogenous* high content of W in the binder phase is prescribed. It is considered not to be obvious to a person skilled in the art, in light of the cited document, to prescribe a high overall content of W dissolved in the cobalt binder phase in a cemented carbide having the defined particle size distribution.

Cited document US, A, 4 923 512 relates to a cemented carbide in which the carbide grains, including WC, in the material have an average size of less than 2.5 μm, desirably less than 1 μm (col 3, ll 19-40, col 6, ll 9-13). This is also indicated in Table II, (col. 9, ll 31-68). Therefore, it is considered that the grain size distribution is in the range 0-4.5 μm. However, there is a low content of dissolved W in the binder phase.

Cited document EP, A2, 240 879 relates to a cemented carbide wire for print pins of a dot printer. The average particle or grain size is 0.2- 1 μm (col 2. ll 1 - 42 and col. 4, ll 37 - 44). Therefore, it is considered that the grain size distribution is in the range 0-4.5 μm. Optionally, the alloy also contains cubic phase hard components in conventional amounts. However, there is no information about the content of W in the binder phase.

Cited document Derwent Abstract of Japan 6-335 808 refers to a WC - based cemented carbide with such a hard phase particle distribution that 90% of the particles are in the range 0.5 - 1.5 μm. However, there is no information about the content of W in the binder phase.

Consequently, the method according to claim 1 and related claim 2 is novel and is not considered to be obvious to a person skilled in the art in light of the cited documents.

The other documents cited in the Search Report were cited to show the general state of the art and were not considered to be of particular relevance.

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

Application No. Patent No.	Publication date *(day month year)*	Filing date *(day/month/year)*	Priority date (valid claim) *(day month year)*
JP,A,9-125185	13.05.1997	06.11.1995	

& Dialog Information Services , File 351, DERWENT WPI,
Dialog accession no. 011397725, WPI accession no. 97-375632/199735,
(KOBE STEEL LTD), "Hard tough cemented carbide - comprises mainly tungsten carbide, cobalt and nickel",
& JP,A, 9-125185, 19970513, 199735 B

The document, according to the Abstract, relates to a cemented carbide with a mean WC particle size of 2 - 8 µm, and a small standard deviation.

2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure *(day/month/year)*	Date of written disclosure referring to non-written disclosure *(day month year)*

Claims

25 -08- 1998

1. A cemented carbide insert provided with a thin wear resistant coating with excellent properties for machining of steels and stainless steels consisting of WC, 5 - 12.5 wt-% Co and 0 - 10 wt-% cubic carbides such as TiC, TaC, NbC or mixtures thereof in which the WC-grains have an average grain size in the range 1.0 - 3.0 mm c h a r a c t e r i s e d in that the WC grains have a narrow grain size distribution in the range 0.5 - 4.5 mm and the W-content in the binder phase expressed as the "CW-ratio" defined as

$$\text{CW-ratio} = M_S / \text{wt\%Co} * 0.0161$$

where M_S is the measured saturation magnetization of the sintered cemented carbide insert in kA/m and wt% Co is the weight percentage of Co in the cemented carbide is 0.86 - 0.96.

2. A cemented carbide insert according to the preceding claim c h a r a c t e r i s e d in that said coating comprises $TiC_XN_VO_Z$ with columnar grains followed by a layer of a-Al_2O_3, k-Al_2O_3 or a mixture of a- and k-Al_2O_3.

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

PCT

DEMAND

CHAPTER II

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty.

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference: **AO-11123 DE**

International application No.	International filing date (*day/month/year*)	(Earliest) Priority date (*day/month/year*)
PCT/SE97/01243	08.07.97	19.07.96

Title of invention: Cemented carbide insert for turning, milling and drilling

Box No. II APPLICANT(S)

Name and address: (*Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.*)

SANDVIK AB; (publ)
SE-811 81 SANDVIKEN
Sweden

Telephone No.: +46-26-260000
Facsimile No.: +46-26-261089
Teleprinter No.: 47000 sandvik s

State (*i.e. country*) of nationality:	State (*i.e. country*) of residence:
Sweden	Sweden

Name and address: (*Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.*)

WALDENSTRÖM Mats
Thaliavägen 31
S-167 71 BROMMA
Sweden

State (*i.e. country*) of nationality:	State (*i.e. country*) of residence:
Sweden	Sweden

Name and address: (*Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.*)

ÖSTLUND Åke
Terrängvägen 96
S-129 47 HÄGERSTEN
Sweden

State (*i.e. country*) of nationality:	State (*i.e. country*) of residence:
Sweden	Sweden

☒ Further applicant(s) and/or (further) inventor(s) are indicated on a continuation sheet.

International application No.
PCT/SE97/01243

Continuation of Box No. II APPLICANT(S)

If none of the following sub-boxes is used, this sheet is not to be included in the demand.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

ALM Ove
Storsvängen 136
S-129 44 HÄGERSTEN
Sweden

State *(i.e. country)* of nationality: Sweden

State *(i.e. country)* of residence: Sweden

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

☐ Further applicant(s) and/or (further) inventor(s) are indicated on another continuation sheet.

International application No.
PCT/SE97/01243

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following persons are ☒ agents ☐ common representative

and ☒ have been appointed earlier and represents the applicant(s) also for international preliminary examination.

☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

ÖSTLUND Alf or TÅQUIST Lennart
both of

Sandvik AB, Patent Dept
SE-811 81 SANDVIKEN
Sweden

Telephone No.
+46-26-261094 / 90

Facsimile No.
+46-26-261089

Teleprinter No.
47000 sandvik s

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV STATEMENT CONCERNING AMENDMENTS

The applicant wishes the International Preliminary Examining Authority*

(i) ☒ to start the international preliminary examination on the basis of the international application as originally filed.

(ii) ☐ to take into account the amendments under Article 34 of

- ☐ the description (amendments attached).
- ☐ the claims (amendments attached).
- ☐ the drawings (amendments attached).

(iii) ☐ to take into account any amendments of the claims under Article 19 filed with the International Bureau (a copy is attached).

(iv) ☐ to disregard any amendments of the claims made under Article 19 and consider them as reversed.

(v) ☐ to postpone the start of the international preliminary examination until the expiration of 20 months from the priority date unless that Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired).*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Box No. V ELECTION OF STATES

☒ The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)* except .....

.....

.....

.....

(If the applicant does not wish to elect certain eligible States, the name(s) or country code(s) of those States must be indicated above.)

International application No.
PCT/SE97/01243

Box No. VI CHECK LIST

The demand is accompanied by the following documents for the purposes of international preliminary examination

			For International Preliminary Examining Authority use only: received	not received
1. amendments under Article 34				
description	:	sheets	☐	☐
claims	:	sheets	☐	☐
drawings	:	sheets	☐	☐
2. letter accompanying amendments under Article 34	:	sheets	☐	☐
3. copy of amendments under Article 19	:	sheets	☐	☐
4. copy of statement under Article 19	:	sheets	☐	☐
5. other *(specify):*	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. ☐ separate signed power of attorney
2. ☐ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☒ fee calculation sheet
5. ☐ other *(specify):*

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious fro reading the demand).

Sandviken, Sweden January 15, 1998

SANDVIK AB; (publ)

Alf Östlund

Lennart Tåquist

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:
2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):
3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.
4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5
5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Preliminary Examining Authority use only

Demand received from IPEA on:

PCT

CHAPTER II

FEE CALCULATION SHEET

Annex to the Demand for international preliminary examination

International Application No. PCT/SE97/01243	For International Preliminary Examining Authority use only
Applicant's or agent's file reference **AO-11123 DE**	Date stamp of the IPEA

Applicant
SANDVIK AB

Calculation of prescribed fees

1. Preliminary examination fee	4.200	P
2. Handling fee *(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)*	1.250	H
3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box	5.450 TOTAL	

Mode of Payment

- ☐ authorization to charge deposit account with the IPEA (see below)
- ☐ cash
- ☐ cheque
- ☐ revenue stamps
- ☐ postal money order
- ☐ coupons
- ☐ bank draft
- ☐ other *(specify)*: *from Deposit Account at PRV*

Deposit Account Authorization *(this mode of payment may not be available at all IPEAs)*

The IPEA/_____

☐ is hereby authorized to charge the total fees indicated above to my deposit account.

☐ *(this check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)* is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

Deposit Account Number _____ Date */day/month/year)* _____ Signature _____

See Notes to the fee calculation sheet

cc: AB 19.11.98

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Sandvik AB (publ)
Patent Department
811 81 SANDVIKEN

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	16-11-1998
Applicant's or agent's file reference: AO-11123 DE	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE97/01243	08-07-1997	19-07-1996

Applicant
Sandvik Aktiebolag (publ)
et al

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in som Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary axamination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/
Patent- och registreringsverket
Box 5055
S-102 42 STOCKHOLM
Facsimile No. 08-667 72 88
Telex
17978
PATOREG-S

Authorized officer
Pernilla Hörth
Telephone No. 08-782 25 00

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference AO-11123 DE	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/SE97/01243	International filing date *(day/month/year)* 08.07.1997	Priority date *(day/month/year)* 19.07.1996
International Patent Classification (IPC) or national classification and IPC_6 C22C 29/08		
Applicant Sandvik AB (publ) et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16.01.1998	11.11.1998
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Nils Engnell Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE97/01243

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages 1-15, as originally filed,
pages _____, filed with the demand,
pages _____, filed with the letter of _____,
pages _____, filed with the letter of _____.

☒ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. 1,2, filed with the letter of 25.08.1998,
Nos. _____, filed with the letter of _____.

☒ the drawings, ~~sheets~~/fig 1-2, as originally filed,
~~sheets~~/fig _____, filed with the demand
~~sheets~~/fig _____, filed with the letter of _____,
~~sheets~~/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1,2	YES
	Claims		NO
Inventive step (IS)	Claims	1,2	YES
	Claims		NO
Industrial applicability (IA)	Claims	1,2	YES
	Claims		NO

2. Citations and explanations

The originally filed claims are substituted by amended claims 1 and 2 directed to a cemented carbide insert provided with a thin wear resistant coating for machining of steels and stainless steels. According to claim 1, the insert is based on WC, optionally not more than 10 wt-% cubic carbides and 5 - 12.5 wt-% Co. The WC grains have an average grain size in the range 0.2-3.5 µm. The insert is characterised by a WC grain size distribution in the range 0-4.5 µm and by a high content of dissolved W in the cobalt binder phase, which is expressed by a formula. In claim 2 coatings are defined.

Cited document US,A, 3 660 050 relates to a cemented carbide for cutting tools. The material has a very fine structure, *i. e.*, fine WC grains. Preferably WC powder having anisodimensional particles with a thickness of 0.05-1 µm and a length/breadth of 0.2-4 µm is used (col. 4, ll 26-32, col. 6, ll 11-32). In Example 3, a WC powder having grains (particles) in the size range 0.5-2 µm with an average size of 5-1 µm is used (col. 28, ll 63-75). There is no indication that the sintered cemented carbides have essentially different grain size characteristics. See also Examples 1, 6 and 10. Therefore, in the cemented carbide according to US, A, 3 660 050 the WC grains have an average grain size in the range 0.2-3.5 µm and a grain size distribution in the range 0-4.5 µm. However, the cemented carbide according to the document has a *heterogenous* binder regarding the W (Tungsten) content in the binder phase, a high content being preferred (col. 4, l. 43 - col. 5, l 34). The content of W dissolved in the cobalt binder phase is regulated by the carbon content, *c.f.* the present description p 4, ll 4 - 14.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

Consequently, the invention defined in claim 1 is novel in that a *homogenous* high content of W in the binder phase is prescribed. It is considered not to be obvious to a person skilled in the art, in light of the cited document, to prescribe a high overall content of W dissolved in the cobalt binder phase in a cemented carbide having the defined particle size distribution.

Cited document US, A, 4 923 512 relates to a cemented carbide in which the carbide grains, including WC, in the material have an average size of less than 2.5 µm, desirably less than 1 µm (col 3, ll 19-40, col 6, ll 9-13). This is also indicated in Table II, (col. 9, ll 31-68). Therefore, it is considered that the grain size distribution is in the range 0-4.5 µm. However, there is a low content of dissolved W in the binder phase.

Cited document EP, A2, 240 879 relates to a cemented carbide wire for print pins of a dot printer. The average particle or grain size is 0.2- 1 µm (col 2. ll 1 - 42 and col. 4, ll 37 - 44). Therefore, it is considered that the grain size distribution is in the range 0-4.5 µm. Optionally, the alloy also contains cubic phase hard components in conventional amounts. However, there is no information about the content of W in the binder phase.

Cited document Derwent Abstract of Japan 6-335 808 refers to a WC - based cemented carbide with such a hard phase particle distribution that 90% of the particles are in the range 0.5 - 1.5 µm. However, there is no information about the content of W in the binder phase.

Consequently, the method according to claim 1 and related claim 2 is novel and is not considered to be obvious to a person skilled in the art in light of the cited documents.

The other documents cited in the Search Report were cited to show the general state of the art and were not considered to be of particular relevance.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE97/01243

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

Application No. Patent No.	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date (valid claim) *(day/month/year)*
JP,A,9-125185	13.05.1997	06.11.1995	

& Dialog Information Services , File 351, DERWENT WPI,
Dialog accession no. 011397725, WPI accession no. 97-375632/199735,
(KOBE STEEL LTD), "Hard tough cemented carbide - comprises mainly tungsten carbide, cobalt and nickel",
& JP,A, 9-125185, 19970513, 199735 B

The document, according to the Abstract, relates to a cemented carbide with a mean WC particle size of 2 - 8 µm, and a small standard deviation.

2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure *(day/month/year)*	Date of written disclosure referring to non-written disclosure *(day/month/year)*

Claims

1. A cemented carbide insert provided with a thin wear resistant coating with excellent properties for machining of steels and stainless steels consisting of WC, 5 - 12.5 wt-% Co and 0 - 10 wt-% cubic carbides such as TiC, TaC, NbC or mixtures thereof in which the WC-grains have an average grain size in the range 1.0 - 3.0 mm c h a r a c t e r i s e d in that the WC grains have a narrow grain size distribution in the range 0.5 - 4.5 mm and the W-content in the binder phase expressed as the "CW-ratio" defined as

$$\text{CW-ratio} = M_S / \text{wt\%Co} * 0.0161$$

where M_S is the measured saturation magnetization of the sintered cemented carbide insert in kA/m and wt% Co is the weight percentage of Co in the cemented carbide is 0.86 - 0.96.

2. A cemented carbide insert according to the preceding claim c h a r a c t e r i s e d in that said coating comprises $TiC_xN_vO_z$ with columnar grains followed by a layer of a-Al_2O_3, k-Al_2O_3 or a mixture of a- and k-Al_2O_3.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference AO-11123 DE	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/SE 97/01243	International filing date *(day/month/year)* 8 July 1997	(Earliest) Priority Date *(day/month/year)* 19 July 1996
Applicant Sandvik AB (publ) et al		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] Certain claims were found unsearchable (See Box I).

2. [ ] Unity of invention is lacking (See Box II).

3. [ ] The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing
   - [ ] filed with the international application.
   - [ ] furnished by the applicant separately from the international application,
     - [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - [ ] transcribed by this Authority.

4. With regard to the title,
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established by this Authority to read as follows:

5. With regard to the abstract,
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:
   Figure No. 1
   - [X] as suggested by the applicant.
   - [ ] because the applicant failed to suggest a figure.
   - [ ] because this figure better characterizes the invention.
   - [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C22C 29/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C22C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4923512 A (ED E. TIMM ET AL), 8 May 1990 (08.05.90), column 3, line 19 - line 40; column 9, line 31 - line 68	1,2,4
A		3,5,6,7-10
	--	
X	US 3660050 A (RALPH K. ILER ET AL), 2 May 1972 (02.05.72), column 1, line 1 - column 3, line 9; column 6, line 11 - line 32; column 9, line 13 - line 55, column 31, line 45 - column 32, line 17	1,3,4
A		2,5-6,7-10
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 1997	12 -11- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Nils Engnell Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0240879 A2 (MITSUBISHI KINZOKU KABUSHIKI KAISHA), 14 October 1987 (14.10.87), column 2, line 1 - line 42	1,2
A		3-6,7-10
	--	
X	Dialog Information Services, File 351,DERWENT WPI, Dialog accession no. 010155859,WPI accession no. 95-057111/199508, (NGK SPARK PLUG CO LTD), "Tungstencarbide-base cemented carbide used for cutting tool - comprises hard phase having specified particle size distribution, and contg tungsten carbide and ferrous metal bonding phase", & JP,A,6335808, 19941206, 199508 B	1,2,3
A		4-6,7-10
	--	
P,X	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 011397725, WPI accession no. 97-375632/199735, (KOBE STEEL LTD), "Hard tough cemented carbide - comprises mainly tungsten carbide, cobalt and nickel", & JP,A,9125185, 19970513, 199735 B	1
A		2-6,7-10
	--	
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 011172064, WPI accession no. 97-149989/199714, (DIJET IND CO LTD), "Sintered hard material for water jet or wire drawing die nozzles - comprises iron, cobalt, and/or nickel, carbide and/or carbonitride of Gp-IVA transition metal, and tungsten carbide", & JP,A,9025535, 19970128, 199714 B	1-6,7,10
	--	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 008723156, WPI accession no. 91-227173/199131, (TOSHIBA TUNGALLOY KK), "Coated sintered hard alloy for intermittent cutting - has single or multilayers of ceramics on matrix of tungsten carbide or gp-IVA, pg-VA or gp-VIA carbide(s) or carbonitride(s)", JP,A, 3146677, 19910621, 199131 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 008551086, WPI accession no. 91-055137/199108, (HITACHI TOOL KK),"Super-hard alloy prodn. - comprises hard phase of titanium-carbide, titanium-nitride and tungsten carbide and binder phase of iron-Gp. metal", JP,A, 3006349, 19910111, 199108 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 004689404, WPI accession no. 86-192746/198630, (HITACHI CHOKO KK), "Ultrafine particles sintered hard alloy - comprises tungsten carbide hard phase bonded with iron and chromium gp elements contg. carbid(s)", JP,A, 61124548, 19860612, 198630 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 004675229, WPI accession no. 86-178571/198628, (HITACHI CHOKO KK et al), "Hard alloy useful for cutting tools etc. comprises hard phase contg. tungsten carbide, and binder metal phase contg. iron-gp. and chromium-gp. elements", JP,A,61110745, 19860529, 198628 B --	1-6,7-10
A	EP 0476632 A2 (KAWASAKI JUKOGYO KABUSHIKI KAISHA), 25 March 1992 (25.03.92), page 4, line 36 - page 5, line 19 -- --------	1-6,7-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/97

International application No.
PCT/SE 97/01243

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4923512 A	08/05/90	NONE	
US 3660050 A	02/05/72	AT 299562 A	15/05/72
		BE 751884 A	14/12/70
		CA 924738 A	17/04/73
		CH 545347 A	31/01/74
		DE 2030666 A	07/01/71
		FR 2047071 A	12/03/71
		GB 1315368 A	02/05/73
		LU 61174 A	24/08/70
		NL 7009125 A	28/12/70
		SE 7411630 A	16/09/74
		SE 7411631 A	16/09/74
		ZA 7004219 A	31/03/71
EP 0240879 A2	14/10/87	SE 0240879 T3	
		DE 3784754 A	22/04/93
		JP 1947234 C	10/07/95
		JP 6076639 B	28/09/94
		JP 62227059 A	06/10/87
		US 5068149 A	26/11/91
		US 5288676 A	22/02/94
		JP 62227060 A	06/10/87
EP 0476632 A2	25/03/92	CA 2051765 A,C	21/03/92
		JP 2599044 B	09/04/97
		JP 4365558 A	17/12/92
		KR 9406286 B	14/07/94
		US 5334561 A	02/08/94
		US 5434112 A	18/07/95
		JP 2540672 B	09/10/96
		JP 4348873 A	03/12/92

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C22C 29/08 | A1

(11) International Publication Number: **WO 98/03691**

(43) International Publication Date: 29 January 1998 (29.01.98)

(21) International Application Number: PCT/SE97/01243

(22) International Filing Date: 8 July 1997 (08.07.97)

(30) Priority Data:
9602811-3 19 July 1996 (19.07.96) SE

(71) Applicant *(for all designated States except US)*: SANDVIK AB (publ) [SE/SE]; S-811 81 Sandviken (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: WALDENSTRÖM, Mats [SE/SE]; Thaliavägen 31, S-161 40 Bromma (SE). ÖSTLUND, Åke [SE/SE]; Sedelvägen 12, S-129 32 Hägersten (SE). ALM, Ove [SE/SE]; Storsvängen 136, S-129 44 Hägersten (SE).

(74) Agents: ÖSTLUND, Alf et al.; Sandvik AB, Patent Dept., S-811 81 Sandviken (SE).

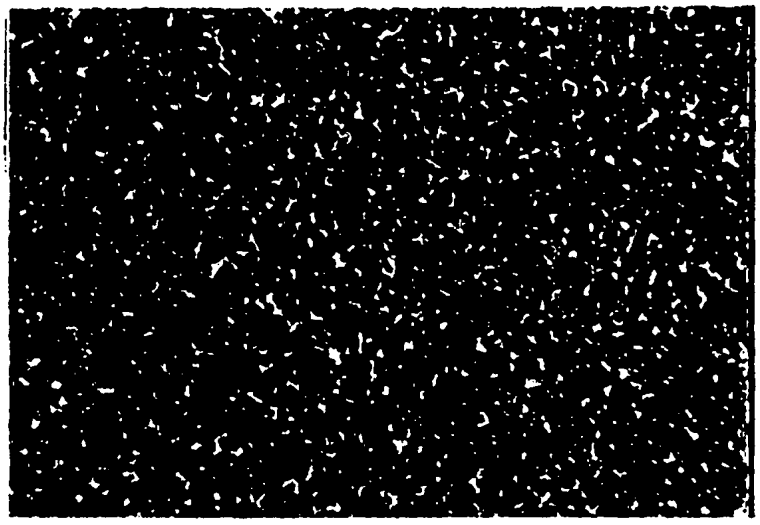
(81) Designated States: CN, JP, KR, RU, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: CEMENTED CARBIDE INSERT FOR TURNING, MILLING AND DRILLING

(57) Abstract

The present invention relates to a cemented carbide insert with excellent properties for machining of steels and stainless steels. The cemented carbide comprises WC and 4-25 wt.% Co. The WC-grains have an average grain size in the range 0.2-3.5 μm and a narrow grain size distribution in the range 0-4.5 μm. According to the method of the invention, a cemented carbide cutting tool insert is made by mixing powders of WC, TiC, TaC and/or NbC, binder metal and pressing agent, drying preferably by spray drying, pressing to inserts and sintering. The method is characterised in that a deagglomerated WC-powder with a narrow grain size distribution is used, that the powders of TiC, TaC and/or NbC are deagglomerated and that the mixing is wet mixing with no change in grain size or grain size distribution.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Cemented carbide insert for turning, milling and drilling

The present invention relates to a cemented carbide cutting tool insert, particularly useful for turning, milling and drilling of steels and stainless steels.

Conventional cemented carbide inserts are produced by powder metallurgical methods including milling of a powder mixture forming the hard constituents and the binder phase, pressing and sintering. The milling operation is an intensive milling in mills of different sizes and with the aid of milling bodies. The milling time is of the order of several hours up to several days. Such processing is believed to be necessary in order to obtain a uniform distribution of the binder phase in the milled mixture. It is further believed that the intensive milling creates a reactivity of the mixture which further promotes the formation of a dense structure. However, milling has its disadvantages. During the long milling time the milling bodies are worn and contaminate the milled mixture. Furthermore even after an extended milling a random rather than an ideal homogeneous mixture may be obtained. Thus, the properties of the sintered cemented carbide containing two or more components depend on how the starting materials are mixed.

There exist alternative technologies to intensive milling for production of cemented carbide, for example, use of particles coated with binder phase metal. The coating methods include fluidized bed methods, solgel techniques, electrolytic coating, PVD coating or other methods such as disclosed in e. g. GB 346,473, US 5,529,804 or US 5,505,902. Coated carbide particles could be mixed with additional amounts of cobalt and other carbide powders to obtain the desired final

material composition, pressed and sintered to a dense structure.

During metal cutting operations like turning, milling and drilling the general properties such as hardness, resistance against plastic deformation, resistance against formation of thermal fatigue cracks are to a great extent related to the volume fraction of the hard phases and the binder phase in the sintered cemented carbide body. It is well known that increasing the amount of the binder phase reduces the resistance to plastic deformation. Different cutting conditions require different properties of the cutting insert. When cutting of steels with raw surface zones (e.g. rolled, forged or cast) a coated cemented carbide insert must consist of tough cemented carbide and have a very good coating adhesion as well. When turning, milling or drilling in low alloyed steels or stainless steels the adhesive wear is generally the dominating wear type.

Measures can be taken to improve the cutting performance with respect to a specific wear type. However, very often such action will have an negative effect on other wear properties.

The influence of some possible measures is given below:

1. Milling, turning or drilling at high cutting speeds and high cutting edge temperature require a cemented carbide with a rather large amount of cubic carbides (a solid solution of WC-TiC-TaC-NbC). Thermal fatigue cracks will often more easily develop in such carbides.

2. The formation of thermal fatigue cracks can be reduced by lowering the binder phase content. However, such action will lower the toughness properties of the cutting insert which is not desirable.

3. Improved abrasive wear can be obtained by increasing the coating thickness. However, thick coatings increase the risk for flaking and will lower the resistance to adhesive wear.

It has now surprisingly been found that cemented carbide inserts made from powder mixtures with hard constituents with narrow grain size distributions and without conventional milling have excellent cutting performance in steels and stainless steels with or without raw surfaces in turning, milling and drilling under both dry and wet conditions.

Fig. 1 shows in 1200X the microstructure of a cemented carbide insert according to the invention.

Fig. 2 shows in 1200X the microstructure of a corresponding insert made according to prior art.

According to the invention there is now provided cemented carbide inserts with excellent properties for machining of steels and stainless steels comprising WC and 4 - 20 wt-% Co, preferably 5 - 12.5 wt-% Co and 0 - 30 wt-% cubic carbide, preferably 0 - 15 wt-% cubic carbide, most preferably 0 - 10 wt-% cubic carbide such as TiC, TaC, NbC or mixtures thereof. The WC-grains have an average grain size in the range 0.8 - 3.5 µm, preferably 1.0 - 3.0 µm. The microstructure of the cemented carbide according to the invention is further characterized by a narrow grain size distribution of WC in the range 0.5 - 4.5 µm, and a lower tendency for the cubic carbide particles, when present, to form long range skeleton, compared to conventional cemented carbide.

In another alternative embodiment there is provided cemented carbide inserts comprising WC and 10 - 25 wt-% Co, preferably 15 - 20 wt-% Co, and <2 wt-%, preferably <1 wt-% cubic carbides such as Cr_3C_2 and/or VC added as grain growth inhibitors. The WC-grains have an average grain size 0.2 - 1.0 µm. The microstructure of cemented

carbide according to the invention is further characterized by a narrow grain size distribution of WC in the range 0 - 1.5 μm.

The amount of W dissolved in binder phase is controlled by adjustment of the carbon content by small additions of carbon black or pure tungsten powder. The W-content in the binder phase can be expressed as the "CW-ratio" defined as

$$\text{CW-ratio} = M_S / (\text{wt\%Co} * 0.0161)$$

where M_S is the measured saturation magnetization of the sintered cemented carbide body in kA/m and wt% Co is the weight percentage of Co in the cemented carbide. The CW-ratio in inserts according to the invention shall be 0.82 - 1.0, preferably 0.86 - 0.96.

The sintered inserts according to the invention are used coated or uncoated, preferably coated with MTCVD, conventional CVD or PVD with or without Al_2O_3. In particular, multilayer coatings comprising $TiC_xN_yO_z$ with columnar grains followed by a layer of α-Al_2O_3, κ-Al_2O_3 or a mixture of α- and κ-Al_2O_3, have shown good results. In another preferred embodiment the coating described above is completed with a TiN-layer which could be brushed or used without brushing.

According to the method of the present invention WC-powder with a narrow grain size distribution is wet mixed without milling with deagglomerated powder of other carbides generally TiC, TaC and/or NbC, binder metal and pressing agent, dried preferably by spray drying, pressed to inserts and sintered.

WC-powder with a narrow grain size distributions according to the invention with eliminated coarse grain tails >4.5 μm and with eliminated fine grain tails, <0.5 μm, are prepared by sieving such as in a jetmill-classifier. It is essential according to the invention that the mixing takes place without milling i.e. there

should be no change in grain size or grain size distribution as a result of the mixing.

Hard constituents with narrow grain size distributions according to the alternative embodiment with eliminated coarse grain tails >1.5 µm are prepared by sieving such as in a jetmill classifier. It is essential according to the invention that the mixing takes place without milling i.e. there should be no change in grain size or grain size distribution as a result of the mixing.

In a preferred embodiment the hard constituents, at least those with narrow grain size distribution, are after careful deagglomeration coated with binder metal using methods disclosed in US 5,505,902 or US 5,529,804. In such case the cemented carbide powder according to the invention consists preferably of Co-coated WC + Co-binder, with or without additions of the cubic carbides, TiC, TaC, NbC, (Ti,W)C, (Ta,Nb)C, (Ti,Ta,Nb)C, (W,Ta,Nb)C, (W,Ti,Ta,Nb)C or Cr_3C_2 and/or VC coated or uncoated, preferably uncoated, possibly with further additions of Co-powder in order to obtain the desired final composition.

Example 1

A. Cemented carbide tool inserts of the type SEMN 1204 AZ, an insert for milling, with the composition 9.1 wt% Co, 1.23 wt% TaC and 0.30 wt% NbC and rest WC with a grain size of 1.6 µm were produced according to the invention. Cobalt coated WC, WC-2 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C and TaC powders to obtain the desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder)

for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with carbon black to a binder phase highly alloyed with W corresponding to a CW-ratio of 0.89. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained, Fig. 1.

Before coating a negative chamfer with an angle of 20° was ground around the whole insert.

The inserts were coated with a 0.5 µm equiaxed TiCN-layer (with a high nitrogen content corresponding to an estimated C/N-ratio of 0.05) followed by a 4 µm thick TiCN-layer with columnar grains by using MTCVD-technique (temperature 885-850 °C and CH_3CN as the carbon and nitrogen source). In subsequent steps during the same coating cycle, a 1.0 µm thick layer of Al_2O_3 was deposited using a temperature 970 °C and a concentration of H_2S dopant of 0.4 % as disclosed in EP-A-523 021. A thin (0.3 µm) layer of TiN was deposited on top according to known CVD-technique. XRD-measurement showed that the Al_2O_3-layer consisted of 100 % κ-phase.

The coated inserts were brushed by a nylon straw brush containing SiC grains. Examination of the brushed inserts in a light microscope showed that the thin TiN-layer had been brushed away only along the cutting edge leaving there a smooth Al_2O_3-layer surface.

Coating thickness measurements on cross sectioned brushed samples showed no reduction of the coating along the edge line except for the outer TiN-layer that was removed.

B. Cemented carbide tool inserts of the type SEMN 1204 AZ with the same chemical composition, average grain size of WC, CW-ratio, chamfering and CVD-coating respectively but produced from powder manufactured with

conventional ball milling techniques, Fig. 2, were used as reference.

Inserts from A were compared to inserts from B in a wet milling test in a medium alloyed steel (HB=210) with hot rolled and rusty surfaces. Two parallel bars each of a thickness of 33 mm were centrally positioned relative to the cutter body (diameter 100 mm) and with an air gap of 10 mm between them.

The cutting data were:

Speed= 160 m/min

Feed= 0.20 mm/rev

Cutting depth= 2 mm, single tooth milling with coolant.

Evaluated life length of variant A according to the invention was 3600 mm and for the standard variant B only 2400 mm. Since the CW-ratio, the negative chamfer and the coatings were equal for variants A and B, the differences in cutting performance depend on the improved properties obtained by the invention.

Example 2

A. Cemented carbide tool inserts of the type SEMN 1204 AZ according to the invention identical to the test specimen (A) in Example 1.

B. Cemented carbide tool inserts of the type SEMN 1204 AZ identical to the reference specimen (B) in Example 1.

C. A strongly competitive cemented carbide grade of the type SEKN 1204 from an external leading carbide producer with the composition 7.5 wt-% Co, 0.4 wt-% TaC, 0.1 wt% NbC, 0.3 wt% TiC rest WC and a CW-ratio of 0.95. The insert was provided with a coating consisting of a 0.5 µm equiaxed TiCN-layer, 2.1 µm columnar TiCN-layer, 2.2 µm κ-Al_2O_3-layer and a 0.3 µm TiN-layer.

Inserts from A were compared against inserts from B and C in a dry milling test in a low alloyed steel (HB=300) with premachined surfaces. A bar with a thickness of 180 mm was centrally positioned relative to the cutter body (diameter 250 mm)

The cutting data were:

Speed= 150 m/min,

Feed= 0.23 mm/rev

Cutting depth= 2 mm, single tooth milling dry conditions.

Insert B broke after 6000 mm after comb crack formation and chipping and insert C broke after 4800 mm by a similar wear pattern. Finally, insert A according to the invention, broke after 8000 mm.

Example 3

A. Cemented carbide tool inserts of the type CNMG 120408-QM, an insert for turning, with the composition 8.0 wt% Co, and rest WC with a grain size of 3.0 µm were produced according to the invention. Cobalt coated WC, WC-8 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with carbon black to a binder phase alloyed with W corresponding to a CW-ratio of 0.93. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with conventional CVD TiN+TiCN, 1+1 µm.

B. Cemented carbide tool inserts of the type CNMG 120408-QM with the same chemical composition, average grain size of WC, CW-ratio and the same CVD-coating respectively but produced from powder manufactured with conventional ball milling techniques were used as reference.

Inserts from A and B were compared in a face turning test where the resistance against plastic deformation was measured as the flank wear. The work piece material was a rather highly alloyed steel, a bar with diameter 180 mm (HB=310). The cutting data were:

Speed= 290 m/min

Feed= 0.30 mm/rev

Depth of cut= 2 mm

The flank wear after two passages (average for three edges per variant) was found to be 0.27 mm for variant A according to the invention and 0.30 for variant B.

Example 4

A. Cemented carbide inserts of the type CNMG120408-MM, an insert for turning, with the composition 10.5 wt-% Co, 1.16 wt-% Ta, 0.28 wt-% Nb and rest WC with a grain size of 1.6 µm were produced according to the invention. Cobalt coated WC, WC-6 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C and TaC powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with carbon black to a binder phase highly alloyed with W corresponding to a CW-ratio of 0.87. After spray drying, the

inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 0.5 µm equiaxed TiCN-layer with a high nitrogen content, corresponding to an estimated C/N ratio of 0.05, followed by a 4.2 µm thick layer of columnar TiCN deposited using MT-CVD technique. In subsequent steps during the same coating process a 1.0 µm layer of Al_2O_3 consisting of pure κ-phase according to procedure disclosed in EP-A-523 021. A thin, 0.5 µm, TiN layer was deposited, during the same cycle, on top of the Al_2O_3-layer.

The coated insert was brushed by a SiC containing nylon straw brush after coating, removing the outer TiN layer on the edge.

B. Cemented carbide tool inserts of the type CNMG120408-MM with the same chemical composition, average grain size of WC, CW-ratio and the same CVD-coating respectively but produced from powder manufactured with conventional ball milling techniques were used as reference.

Inserts from A and B were compared in facing of a bar, diameter 180, with two, opposite, flat sides (thickness 120 mm) in 4LR60 material (a stainless steel).

The cutting data were:

Feed= 0.25 mm/rev,

Speed= 180 m/min and

Depth of cut= 2.0 mm.

The wear mechanism in this test was chipping of the edge.

Result

Insert	Number of cuts
A, according to the invention	19
B	15

Example 5

A. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC with a grain size of 1.6 µm were produced according to the invention. Cobalt coated WC, WC-5 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5 µm layer of TiCN, followed by in subsequent steps during the same coating process a 6 µm layer of Al_2O_3.

B. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC with a grain size of 1.6 µm were produced according to the invention. Uncoated deagglomerated WC was mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain a desired

material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5 µm layer of TiCN, followed by in subsequent steps during the same coating process a 6 µm layer of Al_2O_3.

C. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC produced from powder manufactured with conventional ball milling techniques with the same CW-ratio and almost the same average WC-grain size as insert A and B were coated with the same coating as insert A and B.

Inserts from A, B and C were compared in an external longitudinal turning test with cutting speed 220 m/min and 190 m/min resp., a depth of cut of 2 mm, and a feed per tooth equal to 0.7 mm/revolution. The work piece material was SS 2541 with a hardness of 300 HB and a diameter of 160 mm. The wear criteria in this test was the measure of the edge depression in µm, which reflects the inverse resistance against plastic deformation. A lower value of the edge depression indicates higher resistance against plastic deformation.

The following results were obtained:

	v= 190 m/min edge depression, µm	v= 220 m/min edge depression, µm
A	59	85
B	56	93
C	89	116

Since the general toughness behaviour was similar it is clear that both insert A produced from Co-coated WC and insert B produced from uncoated WC both according to the invention, performed better than insert C produced with conventional techniques.

Example 6

A. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC with a grain size of 1.6 µm were produced according to the invention. Cobalt coated WC, WC-5 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5 µm layer of TiCN, followed by in subsequent steps during the same coating process a 6 µm layer of Al_2O_3.

B. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC with a grain size of 1.6 µm were produced according to the invention. Uncoated deagglomerated WC was mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5 µm layer of TiCN, followed by in subsequent steps during the same coating process a 6 µm layer of Al_2O_3.

C. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC produced from powder manufactured with conventional ball milling techniques with the same CW-ratio and almost the same average WC-grain size as insert A and B were coated with the same coating as insert A and B.

Inserts from A, B and C were compared in a external longitudinal turning test with cutting data 240 m/min, a dept of cut of 2 mm, and a feed per tooth equal to 0.7 mm/revolution. The work piece material was SS 2541 with an hardness of 300 HB and a diameter of 160 mm. The wear criteria in this test was the measure of the maximum flank wear after 5 min in cutting time, which reflects the resistance against plastic deformation.

The following results were obtained

	max. flank wear, µm
A	28
B	35
C	38

Since the general toughness behaviour was similar it is clear that both insert A produced from Co-coated WC, and insert B produced from uncoated WC both according to the invention, performed better than insert C produced with conventional techniques.

Claims

1. A cemented carbide insert with excellent properties for machining of steels and stainless steels comprising WC and 4 - 25 wt-% Co in which the WC-grains have an average grain size in the range 0.2 - 3.5 µm c h a r a c t e r i s e d in that the WC grains have a narrow grain size distribution in the range 0 - 4.5 µm.

2. A cemented carbide insert according to the preceding claim comprising WC, 5 - 20 wt-% Co and 0 - 30 wt-% cubic carbide, preferably 0 - 15 wt-% cubic carbide, most preferably 0 - 10 wt-% cubic carbide such as TiC, TaC, NbC or mixtures thereof in which the WC-grains have an average grain size in the range 0.8 - 3.5 µm preferably 1.0 - 3.0 µm c h a r a c t e r i s e d in that the WC grains have a narrow grain size distribution in the range 0.5 - 4.5 µm.

3. A cemented carbide insert according to claim 1 comprising WC and 10 - 25 wt-% Co, preferably 15 - 20 wt-% Co in which the WC grains have an average grain size 0.2 - 1.0 µm c h a r a c t e r i s e d in a narrow grain size distribution of WC in the range 0 - 1.5 µm.

4. A cemented carbide insert according to any of the preceding claim c h a r a c t e r i s e d in that the W-content in the binder phase expressed as the "CW-ratio" defined as

$$\text{CW-ratio} = M_S \,/\, \text{wt\%Co} * 0.0161$$

where M_S is the measured saturation magnetization of the sintered cemented carbide insert in kA/m and wt% Co is the weight percentage of Co in the cemented carbide shall be 0.82 - 1.0, preferably 0.86 - 0.96.

5. A cemented carbide insert according to any of the preceding claims c h a r a c t e r i s e d in that said insert is provided with a thin wear resistant coating.

6. A cemented carbide insert according to claim 5 c h a r a c t e r i s e d in that said coating comprises

$TiC_xN_yO_z$ with columnar grains followed by a layer of α-Al_2O_3, κ-Al_2O_3 or a mixture of α- and κ-Al_2O_3.

7. Method of making a cemented carbide cutting tool insert by mixing powders of WC, TiC, TaC and/or NbC, binder metal and pressing agent, drying preferably by spray drying, pressing to inserts and sintering c h a r a c t e r i s e d in

- that a deagglomerated WC-powder with a narrow grain size distribution is used,
- that the powders of TiC, TaC and/or NbC are deagglomerated and
- that the mixing is wet mixing with no change in grain size or grain size distribution

8. Method according to claim 7 c h a r a c t e r i s e d in that in the WC-powder with a narrow grain size distribution the coarse grain tails >4.5 μm and fine grain tails, <0.5 μm, are eliminated by sieving such as in a jetmill-classifier.

9. Method according to claim 7 c h a r a c t e r i s e d in that in the WC-powder with a narrow grain size distribution the coarse grain tails >1.5 μm is eliminated by sieving such as in a jetmill-classifier.

10. Method according to any of the claims 7-9 c h a r a c t e r i s e d in that the WC grains are coated with binder metal and deagglomerated prior to the mixing.

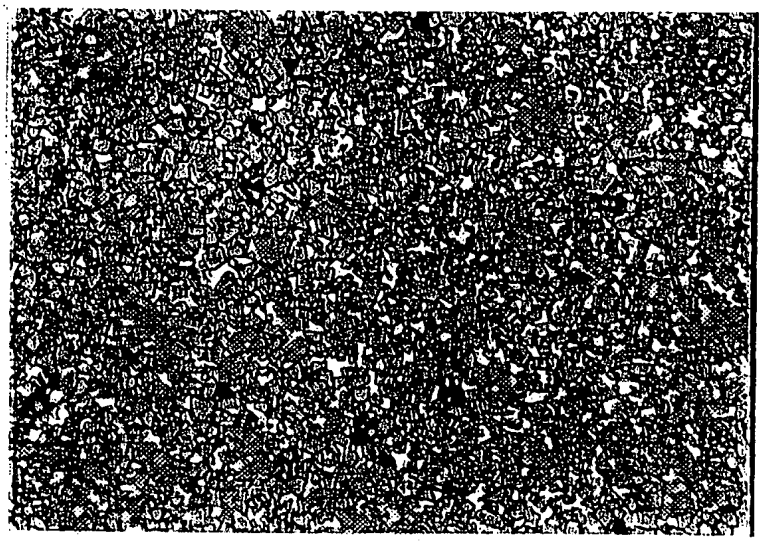


Fig. 1

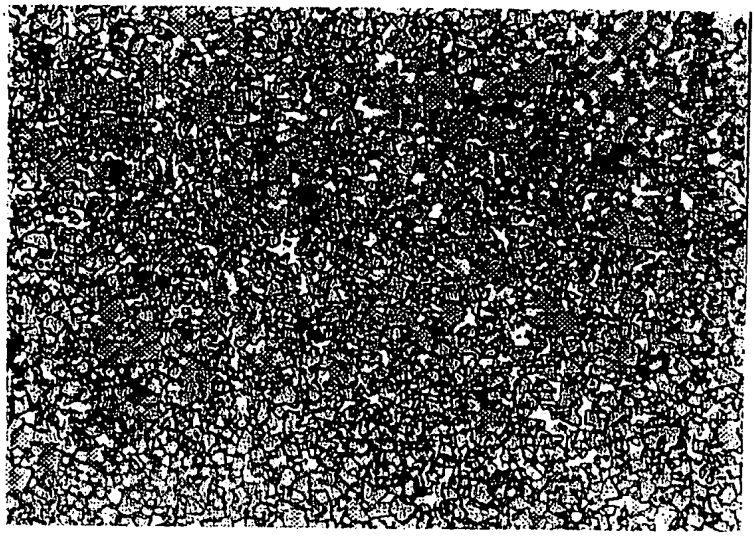


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C22C 29/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C22C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4923512 A (ED E. TIMM ET AL), 8 May 1990 (08.05.90), column 3, line 19 - line 40; column 9, line 31 - line 68	1,2,4
A		3,5,6,7-10
	--	
X	US 3660050 A (RALPH K. ILER ET AL), 2 May 1972 (02.05.72), column 1, line 1 - column 3, line 9; column 6, line 11 - line 32; column 9, line 13 - line 55, column 31, line 45 - column 32, line 17	1,3,4
A		2,5-6,7-10
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 1997	12 -11- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Nils Engnell Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0240879 A2 (MITSUBISHI KINZOKU KABUSHIKI KAISHA), 14 October 1987 (14.10.87), column 2, line 1 - line 42	1,2
A		3-6,7-10
	--	
X	Dialog Information Services, File 351,DERWENT WPI, Dialog accession no. 010155859,WPI accession no. 95-057111/199508, (NGK SPARK PLUG CO LTD), "Tungstencarbide-base cemented carbide used for cutting tool - comprises hard phase having specified particle size distribution, and contg tungsten carbide and ferrous metal bonding phase", & JP,A,6335808, 19941206, 199508 B	1,2,3
A		4-6,7-10
	--	
P,X	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 011397725, WPI accession no. 97-375632/199735, (KOBE STEEL LTD), "Hard tough cemented carbide - comprises mainly tungsten carbide, cobalt and nickel", & JP,A,9125185, 19970513, 199735 B	1
A		2-6,7-10
	--	
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 011172064, WPI accession no. 97-149989/199714, (DIJET IND CO LTD), "Sintered hard material for water jet or wire drawing die nozzles - comprises iron, cobalt, and/or nickel, carbide and/or carbonitride of Gp-IVA transition metal, and tungsten carbide", & JP,A,9025535, 19970128, 199714 B	1-6,7,10
	--	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 008723156, WPI accession no. 91-227173/199131, (TOSHIBA TUNGALLOY KK), "Coated sintered hard alloy for intermittent cutting - has single or multilayers of ceramics on matrix of tungsten carbide or gp-IVA, pg-VA or gp-VIA carbide(s) or carbonitride(s)", JP,A, 3146677, 19910621, 199131 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 008551086, WPI accession no. 91-055137/199108, (HITACHI TOOL KK),"Super-hard alloy prodn. - comprises hard phase of titanium-carbide, titanium-nitride and tungsten carbide and binder phase of iron-Gp. metal", JP,A, 3006349, 19910111, 199108 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 004689404, WPI accession no. 86-192746/198630, (HITACHI CHOKO KK), "Ultrafine particles sintered hard alloy - comprises tungsten carbide hard phase bonded with iron and chromium gp elements contg. carbid(s)", JP,A, 61124548, 19860612, 198630 B --	1-6,7-10
A	Dialog Information Services, File 351, DERWENT WPI, Dialog accession no. 004675229, WPI accession no. 86-178571/198628, (HITACHI CHOKO KK et al), "Hard alloy useful for cutting tools etc. comprises hard phase contg. tungsten carbide, and binder metal phase contg. iron-gp. and chromium-gp. elements", JP,A,61110745, 19860529, 198628 B --	1-6,7-10
A	EP 0476632 A2 (KAWASAKI JUKOGYO KABUSHIKI KAISHA), 25 March 1992 (25.03.92), page 4, line 36 - page 5, line 19 -- --------	1-6,7-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 97/01243

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4923512 A	08/05/90	NONE	
US 3660050 A	02/05/72	AT 299562 A	15/05/72
		BE 751884 A	14/12/70
		CA 924738 A	17/04/73
		CH 545347 A	31/01/74
		DE 2030666 A	07/01/71
		FR 2047071 A	12/03/71
		GB 1315368 A	02/05/73
		LU 61174 A	24/08/70
		NL 7009125 A	28/12/70
		SE 7411630 A	16/09/74
		SE 7411631 A	16/09/74
		ZA 7004219 A	31/03/71
EP 0240879 A2	14/10/87	SE 0240879 T3	
		DE 3784754 A	22/04/93
		JP 1947234 C	10/07/95
		JP 6076639 B	28/09/94
		JP 62227059 A	06/10/87
		US 5068149 A	26/11/91
		US 5288676 A	22/02/94
		JP 62227060 A	06/10/87
EP 0476632 A2	25/03/92	CA 2051765 A,C	21/03/92
		JP 2599044 B	09/04/97
		JP 4365558 A	17/12/92
		KR 9406286 B	14/07/94
		US 5334561 A	02/08/94
		US 5434112 A	18/07/95
		JP 2540672 B	09/10/96
		JP 4348873 A	03/12/92